CLAIMS

What is claimed is:

1. A detector for detecting neutrons and gamma radiation, comprising:

at least one cathode;

wherein the cathode defines an interior surface and an interior volume;

a plastic housing surrounding the cathode;

at least one plastic lid attached to the housing;

wherein the lid encloses the interior volume of the cathode;

at least one anode extending from the lid into the interior volume of the cathode;

at least one working gas disposed within the interior volume of said cathode; and

at least one conductive neutron-capturing layer at least partially disposed on the interior surface of the cathode.

2. A detector as in claim 1, wherein said plastic housing is made from high density polyethylene (HDPE).

3. A detector as in claim 1, wherein said plastic lid is made from high density polyethylene (HDPE).

4. A detector as in claim 1:

wherein said working gas comprises a gas mixture exhibiting high stopping power for charged particles;

wherein said working gas is chosen from the group of gasses consisting essentially of argon and xenon.

5. A detector as in claim 1, wherein said conductive neutron-capturing layer is chosen from the group consisting essentially of lithium-6 (6Li), boron-10 (10B), gadolinium (Gd), a lithium-6 compound, a boron-10 compound, and a

gadolinium compound.

6. A detector as in claim 1, further comprising:
an electrostatic shield layer at least partially covering the housing.

7. A detector as in claim 1, further comprising:
an electrostatic shield layer at least partially covering said lid.

8. A detector as in claim 1, wherein said lid is welded to said housing.

9. A detector as in claim 1, wherein said anode is affixed to a hermetically sealed feed-through insulator that extends from said lid into the interior volume.

10. A detector as in claim 9, wherein said anode is disposed near the center of the interior volume.

11. A detector as in claim 1, further comprising:
a high voltage bias source electrically connected to the cathode.

12. A detector as in claim 1, further comprising:
processing electronics electrically connected to said anode.

13. A detector as in claim 1, wherein said processing electronics includes logic for separating neutron pulses from gamma pulses.

14. A detector for detecting neutrons and gamma radiation, comprising:
an array of cathodes;
wherein half of said cathodes are upward facing;
wherein half of said cathodes are downward facing;
wherein each cathode defines an interior surface and an interior volume;
a plastic housing surrounding said cathodes;

a plastic top cover attached to said housing;

wherein the top cover encloses the interior volumes of said upward facing cathodes;

a plastic bottom cover attached to the housing opposite said top cover;

wherein said bottom cover encloses the interior volumes of said downward facing cathodes;

at least one anode extending from said top cover and said bottom cover into the interior volume of each cathode;

at least one working gas disposed within the interior volume of each cathode; and

at least one conductive neutron-capturing layer at least partially disposed on the interior surface of each cathode.

15. A detector as in claim 14, wherein said plastic housing comprises a high density polyethylene (HDPE).

16. A detector as in claim 14, wherein said top cover comprises a high density polyethylene (HDPE).

17. A detector as in claim 14, wherein said bottom cover comprises a high density polyethylene (HDPE).

18. A detector as in claim 14, wherein said working gas comprises a gas mixture exhibiting high stopping power for charged particles.

19. A detector as in claim 14, wherein said working gas is chosen from the group of gases consisting essentially of argon and xenon.

20. A detector as in claim 14, wherein said conductive neutron-capturing layer is chosen from the group consisting essentially of lithium-6 (6Li), boron-10 (10B), gadolinium (Gd), a lithium-6 compound, a boron-10 compound, and a

gadolinium compound.

21. A detector as in claim 14, further comprising:
an electrostatic shield layer at least partially covering said housing.

22. A detector as in claim 21, further comprising:
an electrostatic shield layer at least partially covering said top cover.

23. A detector as in claim 22, further comprising:
an electrostatic shield layer at least partially covering said bottom cover.

24. A detector as in claim 14, wherein said cover is welded to said housing.

25. A detector as in claim 24, wherein said bottom cover is welded to said housing opposite said top cover.

26. A detector as in claim 14, wherein each said anode is affixed to a hermetically sealed feed-through insulator that extends from said top cover or said bottom cover.

27. A detector as in claim 26, wherein each anode is disposed near the center of a respective interior volume of a said cathode.

28. A detector as in claim 14, further comprising a high voltage bias source electrically connected to the cathodes.

29. A detector as in claim 14, further comprising:
processing electronics electrically connected to each anode.

30. A detector as in claim 29, wherein said processing electronics comprises a single set of processing electronics that is electrically connected to said anodes.

31. A detector as in claim 30, wherein said processing electronics includes logic for separating neutron pulses from gamma pulses.

32. A detector for detecting neutrons and gamma radiation, comprising:

at least one cathode;

wherein said cathode defines an interior surface and an interior volume;

at least one anode extending into the interior volume of said cathode;

at least one working gas disposed within the interior volume of said cathode;

at least one conductive neutron-capturing layer at least partially disposed on the interior surface of said cathode;

at least one high voltage bias source electrically connected to said cathode; and

processing electronics electrically connected to said anode, the processing electronics including logic for separately registering neutron pulses and gamma pulses.

33. A detector as in claim 32, further comprising:

a plastic housing surrounding said cathode.

34. A detector as in claim 33, wherein said plastic housing comprises a high density polyethylene (HDPE).

35. A detector as in claim 33, further comprising:

at least one plastic lid attached to said housing;

wherein said lid encloses the interior volume of said cathode; and

wherein said anode extends from said plastic lid into the interior volume of said cathode.

36. A detector as in claim 35, wherein said plastic lid comprises a high density polyethylene (HDPE).

37. A detector as in claim 35, further comprising:
an electrostatic shield layer at least partially covering said housing.

38. A detector as in claim 35, further comprising:
an electrostatic shield layer at least partially covering said lid.

39. A detector as in claim 35, wherein said lid is welded to said housing.

40. A detector as in claim 35, wherein said anode is affixed to a hermetically sealed feed-through insulator that extends from said lid into said interior volume.

41. A detector as in claim 40, wherein said anode is disposed near the center of the interior volume of said cathode.

42. A detector as in claim 32:
wherein said working gas comprises a gas mixture exhibiting high stopping power for charged particles;
wherein said working gas is chosen from the group of gasses consisting essentially of argon and xenon.

43. A detector as in claim 32, wherein said conductive neutron-capturing layer is chosen from the group consisting essentially of lithium-6 (6Li), boron-10 (10B), gadolinium (Gd), a lithium-6 compound, a boron-10 compound, and a gadolinium compound.

44. A detector for detecting neutrons and gamma radiation, comprising:
at least one cathode;

wherein said cathode defines an interior surface and an interior volume;

at least one anode extending into the interior volume of said cathode;

at least one working gas disposed within the interior volume of said cathode;

at least one conductive neutron-capturing layer at least partially disposed on the interior surface of said cathode;

at least one high voltage bias source electrically connected to said cathode; and

processing electronics electrically connected to said anode and configured with logic for separating neutron pulses from gamma pulses.

45. A detector as in claim 44, wherein said processing electronics includes logic for:

receiving plural current pulses from said anode;

converting said current pulses into a train of overlapping pulses;

converting said train of overlapping pulses into plural Gaussian pulses;

sending each Gaussian pulse having an amplitude above a predetermined threshold to a pulse counter; and

integrating each Gaussian pulse having an amplitude below the predetermined threshold to establish plural integrated pulses.

46. A detector as in claim 45, wherein said processing electronics further includes logic for:

processing said train of overlapped pulses to yield processed pulses, each processed pulse having a rise time that matches a rise time of each integrated pulse.

47. A detector as in claim 46, wherein said processing electronics further includes logic for:

processing each processed pulse to match the height of each processed pulse with each integrated pulse.

48. A detector as in claim 47, wherein said processing electronics further includes logic for:

canceling each processed pulse having an amplitude above a predetermined threshold.

49. A detector as in claim 48, wherein said processing electronics further includes logic for:

subtracting each processed pulse having an amplitude below the predetermined threshold as an average current proportional to a neutron count rate in the pulse counter.

50. A detector as in claim 49, wherein said processing electronics further includes logic for:

outputting a direct current signal (DC) representing gamma pulses.

51. A method for detecting neutrons and gamma radiation, comprising:

providing at least one cathode having an interior surface and an interior volume;

providing a plastic housing around said cathode;

providing at least one anode that extends into the interior volume of each said cathode;

providing at least one working gas within the interior volume of said cathode;

providing at least one conductive neutron-capturing layer at least partially disposed on the interior surface of said cathode;

providing at least one high voltage bias source that is electrically connected to said cathode; and

providing processing electronics that are electrically connected to said anode, said processing electronics including logic for separating neutron pulses from gamma pulses.

52. A detector as in claim 51, wherein said processing electronics includes logic for:

receiving plural current pulses from said anode;

converting said current pulses into a train of overlapped pulses;

converting said train of overlapped pulses into plural Gaussian pulses;

sending each Gaussian pulse having an amplitude above a predetermined threshold to a pulse counter; and

integrating each Gaussian pulse having an amplitude below said predetermined threshold to establish plural integrated pulses.

53. A detector as in claim 52, wherein said processing electronics further includes logic for:

processing said train of overlapped pulses to yield processed pulses, each processed pulse having a rise time that matches a rise time of each integrated pulse.

54. A detector as in claim 53, wherein said processing electronics further includes logic for:

processing each processed pulse to match the height of each processed pulse with the height of each integrated pulse.

55. A detector as in claim 54, wherein said processing electronics further includes logic for:

canceling each processed pulse having an amplitude above a predetermined threshold.

56. A detector as in claim 55, wherein said processing electronics further includes logic for:

subtracting each processed pulse having an amplitude below said predetermined threshold as an average current proportional to a neutron count rate in the pulse counter.

57. A detector as in claim 56, wherein said processing electronics further includes logic for:

outputting a direct current signal (DC) representing gamma pulses.

58. A method of manufacturing a radiation detector, comprising:

manufacturing a plastic body and a lid by injection molding;

fusing a feedthrough insulator, with retained feedthrough electrode, and a pinch-off tube within said lid;

metalizing the entire inner surface of said plastic body and said lid, except contact surfaces between said body and lid, said feedthrough insulator and said pinch-off tube;

laminating over the metalization with 6Li foil;

joining said lid to said plastic body and sealing the surfaces;

evacuating the entire volume of the detector chamber retained within said plastic body covered by said lid;

filling said entire volume with working gas;

sealing said entire volume to prevent loss of working gas;

connecting exterior chamber metalization to ground potential; and

connecting said feedthrough electrode to electronics circuitry for registering gamma and neutron activity.

59. A method of manufacturing a radiation detector, comprising:

forming a metal part having separate cathode cavities ups;

forming a metal lid with an aperture through which an insulated electrode may be retained;

installing and sealing said insulated electrode into said lid;

applying a 6Li layer to the interior of said cavity and said lid;

joining said lid to said cavity;

encapsulating one or more said joined cavities with lids;

evacuating the entire volume within each of said joined cavity with lids;

filling said entire volume with working gas and sealing it; and applying an electroconductive material to the exterior of said encapsulated cavities as electrostatic shielding.